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Oceanic convective mixing and the improved air-sea gas transfer velocity applied to the Baltic Sea biogeochemical cycle

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The Baltic-C project aims at building predictive capability regarding the Baltic Sea organic/inorganic carbon and oxygen systems during present and future climate conditions. This modeling framework will be used for the predictive analysis of the functioning and dynamics of the Baltic Sea organic/inorganic carbon and oxygen systems. Significant components of the Baltic Sea carbon and oxygen systems relates to the uptake/release to the atmosphere. Air-sea exchange is controlled by the difference in concentration between the water surface and the atmosphere, but also by the efficiency of the transfer. Combination of surface water cooling and a deep ocean mixed layer generates convective eddies scaling with the depth of a mixed layer that enhances the efficiency of the air-sea transfer of CO2 (and possibly other gases). This enhancement is explained by the convective eddies disturbing the molecular diffusion layer and inducing increased turbulent mixing in the water (Rutgersson and Smedman, 2010; Rutgersson et al 2011). The enhancement can be introduced into existing formulations for calculating the air-sea exchange of gases by using an additional resistance, due to large-scale convection acting in parallel with other processes. The additional resistance is expressed by the convective velocity scale of the water and the friction velocity and characterizes the relative role of surface shear and buoyancy forces. Improving the description of the air-sea transfer velocity changes the distribution of the air-sea exchange in time and space.

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